FILTERS FOR USE WITH FUEL PUMPS AND FUEL PUMPS HAVING SUCH FILTERS

[0000]

This application claims priority to Japanese patent application serial number 2002-321798, the contents of which are incorporated herein by reference.

[0001]

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to filters for use with fuel pumps, and in particular to filters that are adapted to supply fuels to internal combustion engines. The present invention also relates to fuel pumps having such filters.

[0002]

Description of the Related Art

Japanese Laid-Open Utility Model Publication No. 63-151991 teaches a known structure for mounting a filter onto a fuel pump (see FIGS. 1, 2 and 3 of this reference). The fuel pump has a fuel inlet formed in an end cover of the fuel pump. The fuel inlet opens in a diametrical direction of an impeller. A strainer or a filter is fitted into the fuel inlet in a direction substantially parallel to the open direction of the fuel inlet. In the fitted state, the lower surface of the filter is positioned at substantially the same level as the lower surface of the impeller opposing to the end cover.

[0003]

However, with this mounting structure, the filter must have a long length in a direction perpendicular to a longitudinal axis of the fuel pump (i.e., a diametrical direction of the fuel pump), in order to ensure the necessary filtration area. Therefore, the length of the filter may become greater than a diameter of an upper opening of a fuel tank, which opening is provided for inserting the fuel pump into the fuel tank . As a result, when the fuel pump is inserted into the fuel tank through the upper opening, it is necessary to carefully position the filter or to incline the filter not to interfere with the circumferential edge of the upper opening of the fuel tank. If the filter contacts the circumferential edge of the upper opening of the fuel tank, the fitting portion of the filter onto the fuel pump or the filter itself may be damaged. In order to dissolve this problem, one possible way is to design the upper opening of the fuel tank with a

large diameter. However, the sealing property of the upper opening of the fuel tank may be degraded as the diameter of the upper opening increases.

[0004]

It is accordingly an object of the present invention to teach improved techniques for reducing or minimizing extension lengths of filters from fuel pumps in directions substantially perpendicular to longitudinal axes of the fuel pumps.

[0005]

According to one aspect of the present teachings, filters for use with fuel pumps are taught. The filters have a filter element that extends along the outer surface of the fuel pump. For example, the filter element may have a circular configuration and may surround the fuel pump from a lateral side and from one side in the axial direction.

[0006]

Because the filter element extends along the outer surface of the fuel pump, the length of the filter element in a direction perpendicular to the longitudinal axis of the fuel pump can be reduced or minimized while an effective filtration area of the filter element can be ensured. In addition, because the filter element extends outward from the fuel pump by a minimum distance, the filter element may not interfere with a peripheral portion of an insertion opening of a fuel tank when the fuel pump is mounted within the fuel tank through the insertion opening. Therefore, damages on the filter element may be reduced or minimized, while the insertion opening may have a small size.

[0007]

According to another aspect of the present teachings, the filter element is coupled to a filter body that may be fitted onto the fuel pump from a side opposing to a bottom wall of a fuel tank when the fuel pump is mounted within the fuel tank. Therefore, the filter body may be prevented from being removed from the fuel pump after the fuel pump has been mounted within the fuel tank. Preferably, the filter body is configured to receive a portion of the fuel pump including a closed end that opposes to the bottom wall of the fuel tank.

[0008]

According to another aspect of the present teachings, a spacer may be disposed between a bottom portion of the filter body and a bottom wall of the fuel tank, so that the filter element

can be prevented from contacting the bottom wall. Preferably, the spacer is a projection(s) that extends from the bottom portion of the filter body.

[0009]

According to another aspect of the present teachings, fuel pumps are taught that include the filters as described in the previous aspects.

[0010]

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a representative fuel pump and showing the sate where the fuel pump is mounted within a fuel tank;

FIG. 2 is a plan view of a representative filter; and

FIG. 3 is a plan view of a filter according to an alternative embodiment.

[0011]

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment of the present teachings, filters for use with fuel pumps are taught. The fuel pump may include an inlet channel(s) that is open in an outer surface of the fuel pump in a direction substantially perpendicular to a longitudinal axis of the fuel pump. The filters include a filter body and a filter element. The filter body is adapted to be attached to the fuel pump and has an opening for communicating with the inlet channel of the fuel pump. The filter element is coupled to the filter body and defines a filter chamber that communicates with the opening of the filter body. The filter element extends along at least a part of the outer surface of the fuel pump. For example, the filter body may be attached to the outer surface of the fuel pump by press fitting or by using fasteners.

[0012]

Because the filter element extends along the outer surface of the fuel pump, an effective filtration area of the filter element can be ensured without extending the filter element in a direction away from the fuel pump. In addition, the filter element may not interfere with a peripheral portion of an insertion opening of a fuel tank when the fuel pump is mounted within the fuel tank through the insertion opening. Therefore, damages on the filter element and/or the filter body may be reduced or minimized, while the insertion opening may have a small size.

[0013]

For example, the filtration element may extend in a circumferential direction of the outer surface of the fuel pump and/or the filtration element may extend along a closed end of the fuel pump. The closed end may be disposed at one end in a direction along the longitudinal axis of the fuel pump. Preferably, the filter element may have a substantially circular configuration and may extend along the entire circumferential length of the outer surface of the fuel pump to surround the outer surface of the fuel pump. Therefore, a large effective filtration area of the filter element can be ensured.

[0014]

Preferably, at least a part of the filter chamber may be delimited by an outer surface of the filter body.

[0015]

In another embodiment of the present teachings, the filter body is attached to the fuel pump in a direction substantially parallel to the longitudinal axis of the fuel pump.

[0016]

Preferably, the filter body is configured to receive at least a portion of the outer surface of the fuel pump including a closed end in a direction along the longitudinal axis of the fuel pump. For example, the filter body may have a configuration corresponding to at least a part of a cylindrical tube with a closed bottom.

[0017]

In another embodiment of the preset teachings, the fuel pump is adapted to be mounted within a fuel tank. The fuel tank may have an insertion opening for inserting the fuel pump into the fuel tank.

[0018]

Preferably, the filter body may be fitted onto the fuel pump from a side opposing to a bottom wall of the fuel tank when the fuel pump is mounted within the fuel tank. Therefore, after the fuel pump has been mounted within the fuel tank, the filter body may not be accidentally removed from the fuel pump due to the interference by the bottom wall of the fuel tank

[0019]

Preferably, an area of the filter element as viewed in a direction parallel to the longitudinal axis of the fuel pump is smaller than an area of the insertion opening of the fuel

tank. Therefore, the fuel pump can be easily inserted into the fuel tank through the insertion opening while the fuel pump is maintained in an upright position.

[0020]

In another embodiment of the present teachings, the filter body has a bottom portion that oppose to a bottom wall of a fuel tank when the fuel pump is mounted within the fuel tank. A spacer may be disposed between the bottom portion of the filter body and the bottom wall of the fuel tank, so that the filter element does not contact the bottom wall of the fuel tank. Therefore, the filter element can be prevented from being damaged due to contact with the bottom wall. Preferably. the spacer includes at least one projection that extends from the bottom portion of the filter body.

[0021]

In another embodiment of the present teachings, fuel pumps are taught that include filters as described in the above embodiments.

[0022]

Each of the additional features and teachings disclosed above and below may be utilized separately or in conjunction with other features and teachings to provide improved filters and fuel pumps and methods of using such filters and fuel pumps. Representative examples of the present invention, which examples utilize many of these additional features and teachings both separately and in conjunction, will now be described in detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed in the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe representative examples of the invention. Moreover, various features of the representative examples and the dependent claims may be combined in ways that are not specifically enumerated in order to provide additional useful embodiments of the present teachings.

[0023]

A representative embodiment will now be described with reference to FIG. 1. Referring to FIG. 1, there is shown a representative fuel pump 1 in a vertical sectional view. Upper and

lower housing members 3 and 4 are assembled with each other to constitute a pump housing that is disposed within a lower portion of a main casing 2. An upper side of the lower housing member 4 is recessed to rotatably receive an impeller 5. The impeller 5 is coupled to a rotary shaft 6a of a motor 6, so that the impeller 5 rotates within the lower housing member 4 as the motor 6 is started. A plurality of fins 5a are formed on either side of the impeller 5. The fins 5a in each side of the impeller 5 are spaced equally from each other in the circumferential direction of the impeller 5. The fins 5a on each side of the impeller 5 may be defined by recesses, which recesses are formed in the impeller 5 and are arranged in the circumferential direction of the impeller 5.

[0024]

A first main flow channel 3a and a second main flow channel 4a are defined in the upper housing member 3 and the lower housing member 4, respectively. The first main flow channel 3a and the second main flow channel 4a oppose to the fins 5a disposed on the upper side and the lower side of the impeller 5, respectively, so that pump chambers are defined by the first main flow channel 3a and the fins 5a opposing to the first main channel 3a and by the second main flow channel 4a and the fins 5a opposing to the second main channel 4a.

[0025]

A first inlet channel 3b is defined in the upper housing members 3 and communicates with one end of the main flow channel 3a. A second inlet channel 4b is defined in the lower housing member 4 and communicates with the second main flow channel 4a. Each of the first and second inlet channels 3b and 4b opens to the outside of the fuel pump 1 to define a fuel inlet. The other end of the first main flow channel 3a and the other end of the second main flow channel 4a communicate with a single discharge channel 3c defined in the upper housing member 3, so that the flow of a fuel from the first main flow channel 3a and the flow of the fuel from the second main flow channel 4a may converge at the discharge channel 3c. The fuel then flows out of the discharge channel 3c into an internal space 1a via an outlet opening 3d. The internal space 1a is defined within the main casing 2. An upper cover 7 is fixedly fitted into the upper portion of the main casing 2 and rotatably supports one end of the rotary shaft 6a of the motor 6. An outlet hole 7a is defined within the upper cover 7, so that the fuel discharged from the discharge channel 3c flows through the internal space 1a around the motor 6 and then flows out of the fuel pump 1 via the outlet hole 7a.

[0026]

A representative filter 8 is fitted onto the lower portion of the fuel pump 1 and around the pump housing. The filter 8 includes a filter body 9 and a filter element 10 that are molded simultaneously and integrally with each other by an appropriate molding process. Preferably, the filter body 9 and the filter element 10 may be made of synthetic resin, so that the filter body 9 and the filter element 10 can be molded simultaneously and integrally with each other. Alternatively, the filter element 10 may be made of metal.

[0027]

The filter element 10 may have a meshed configuration in order to filtrate the fuel. The filter body 9 has a cylindrical tubular configuration with an upper opening and a lower closed bottom. The filter body 9 may be fitted onto the lower portion of the fuel pump 1 from the lower side of the fuel pump 1 in a direction parallel to a longitudinal axis L of the fuel pump 1, so that the filter body 9 closely and frictionally contacts the pump housing, i.e., the lower portion of the fuel pump 1, to extend over the openings of the inlet channels 3b and 4b. In this representative embodiment, the longitudinal axis L coincides with the longitudinal axis of the main casing 2 and also coincides with the axis of the rotary shaft 6a of the impeller 5 as well as the central axis of the filter 8. An opening 9a is formed in the filter body 9 in a position opposing to the openings of the inlet channels 3b and 4b, so that the fuel can be drawn into the inlet channels 3b and 4b via the opening 9a. As shown in FIG. 2, the filter element 10 may have a substantially circular configuration in plan view so as to define a filter chamber 10c that substantially entirely surrounds the filter body 5. In other words, the filter chamber 10c entirely surrounds the lower portion including the bottom of the fuel pump 1.

[0028]

The filter element 10 includes an upper portion 10a and a lower portion 10b. The upper portion 10a has a substantially annular configuration in plan view, so that the upper portion 10a has an inner circumferential edge and an outer circumferential edge. The inner circumferential edge of the upper portion 10a is joined to an annular flange 9c that is formed integrally with the filter body 9 in a position adjacent to and above the opening 9a. The lower portion 10b has a substantially circular configuration and extends to cover the bottom of the filter body 9 in a spaced relationship therewith. The outer circumferential edge of the upper portion 10a and an

outer circumferential edge of the lower portion 10b are joined to each other by bonding, welding or any other appropriate measure well known in the art.

[0029]

In the state shown in FIG. 1, the fuel pump 1 is disposed within a fuel tank 11. The fuel tank 11 has a bottom wall 11a and a top wall 11b. Although not shown in the drawings, the fuel tank 11 also may have a side wall, so that a space 11c for storing the fuel is defined by the bottom wall 11a, the top wall 11b and the side wall. A circular opening 11b1 is defined in the top wall 11a, so that the fuel pump 1 can be inserted into the space 11c of the fuel tank 11 via the opening 11b1. In this representative embodiment, an outer diameter D of the filter element 10 is determined to be smaller than a diameter D1 of the opening 11b

[0030]

A projection 9b may be formed integrally with a bottom portion of the filter body 9 and extends downward from the filter body 9 through the lower portion 10b of the filter element 10. With this arrangement, the filter element 10 may not directly contact the bottom plate 11a. Therefore, the filter element 10 may be prevented from being damaged. In addition, it is possible to ensure the filtration operation by a portion of the filter element 10 opposing to the bottom plate 11a. Although not shown in the drawings, a support mechanism may be provided for supporting the fuel pump 1 in an upright position shown in FIG. 1 and may include a biasing device, e.g. a spring that biases the fuel pump in the downward direction toward the bottom wall 11a, so that the projection 9b of the filter 8 normally contacts the bottom wall 11a of the fuel tank 11.

[0031]

With the arrangement of this representative embodiment, because the outer diameter D of the filter element 10 is smaller than the diameter D1 of the opening 11b of the fuel tank 11, the fuel pump 1 can be inserted into the fuel tank 11 through the opening 11b without inclining the longitudinal axis L of the fuel pump 1 relative to the opening 11b. Thus, the fuel pump 1 can be inserted into the opening 11b of the fuel tank 11 in an upright position without causing any contact between the filter 8 and the peripheral edge of the opening 11b.

[0032]

Although the filter 8 is configured to enclose the bottom portion of the fuel pump 1 entirely in the circumferential direction in the above representative embodiment, the filter 8

may have any other configurations as long as it can at least partly surround the lower portion of the fuel pump 1 and can be fitted onto the bottom of the fuel pump 1 in a direction parallel to the longitudinal axis L of the fuel pump 1. For example, in an alternative embodiment shown in FIG. 3, a filter body 9A has a substantially semi-cylindrical configuration and a filter element 10A has a semi-circular configuration corresponding to the configuration of the filter body 9A. In FIG. 3, like members are given the same reference numerals as FIGS. 1 and 2 and an explanation of these members will not be necessary.

[0033]

In addition, although the filter 8 is fixed in position relative to the fuel pump 1 through friction between the filter body 9 and the lower portion of the fuel pump 1, the filter body 9, may be fixed in position relative to the lower portion of the fuel pump 1 by any other fixing or tightening means such as fasteners.

[0034]

Further, although the filter 8 of the representative embodiment has a single projection 9b, a plurality of projections 9b may be formed on the bottom of the filter body 9, so that the fuel pump 1 can be positioned in stable relative to the fuel tank 11. In addition, the projection(s) 9b may be formed separately from the filter body 9 and may be joined to the bottom of the fuel pump 1.

[0035]

Furthermore, although the opening 11b of the fuel tank 11 has a circular configuration in the representative embodiment, the opening 11b may have any other configurations such as polygonal configurations and elliptical configurations.